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A
REPORT,
DESCRIPTIVE OF A
# ROUTE FOR A RAIL ROAD
FROM
The HUDSON through PATERSON
TO THE
DELAWARE RIVER,
THENCE TO
THE SUSQUEHANNA
AND
THE SOUTH WESTERN COUNTIES OF NEW-YORK.

COMPREHENDING BRIEF CONSIDERATIONS
ON INTERNAL IMPROVEMENT BY NATIONAL REVENUE;
THE DESCRIPTION OF ROUTES;
THE EFFECT OF LOCOMOTIVE ENGINES THEREON;
THE RATIO OF FRICTION;
ON INCLINED PLANES;
ON THE COST OF DIFFERENT KINDS OF RAILWAY;
ON A NEW METHOD SUGGESTED;
THE SOURCES OF INCOME;
ON IRON MINES AND MANUFACTURE;
ON THE HOUSATONICK RAILWAY TO THE SOUND;
WITH A LETTER ON THE PENNSYLVANIA SECTION.

NEW-YORK:
PRINTED BY CLAYTON & VAN NORDEN,
No. 42 William-street.
1831.

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REPORT, &c.

PATERSON, 21*st September*, 1831.

To ROSWELL L. COLT, Esq.
Paterson.

SIR,

Agreeably to your request I have examined the ground from this place to *Delaware River*, in order to find the most favourable route for a rail road to the *Water Gap*, to meet that now in the process of location thither from the Susquehanna, under a law of Pennsylvania passed in the year 1826.

In making this investigation I have met with much willing co-operation from many of the principal inhabitants; and I learn the prevailing impression that this naturally rich part of the state in minerals,—water power, and fertility, wants only the facility of a rail road to develop more successfully its resources;—that although not more than sixty miles from market they pay as much for carrying, as districts on the Erie canal pay, *five times as remote*.—that from however far the *line of way* may come, it will be considered as superadding *facility* to the advantage of comparative proximity to the city;—and that these circumstances promotive of successful industry and enterprise, would essentially lessen the inducement now felt to emigrate from hence to the distant west.

In a description of its topographical features this district may well include Orange County, a part of the field I have explored on this occasion. This populous county, with Sussex and Warren, occupy a *tract* extending 80 miles from the Hudson to the Delaware, 30 miles broad: bounded north by the Blue Ridge, south by the Highlands and the Hamburg mountains. These on their eastern side gradually decline with the branches of the Passaic, to which they give rise, while the northwestern side sinks down abruptly. It might be called an extensive valley were it not subdivided into a number, between which hills rise to a height that would be considered *lofty* but for the *presence* of these majestic borders. These give rise to many streams, some of which unite to form the Walkill; others the Pequest and Paulinskill, flowing to the Delaware. These ample sources of supply invited the project of the Sussex and Orange canal, a few years ago; nor would it have been so soon relinquished after the support it received in the approbation of the late Gov. Clinton, and from public opinion, had not a persuasion supervened from European experience, that in our climate, where *winter* is a season of active business, a rail road might be preferable when required to combine rapid travel with commercial conveyance.

The time allowed for the canal to be begun having expired, the field is now open.

In describing the Northern route I shall avail in part of a survey made for a *State road* a few years ago by John Moffatt, Esq., under an order of the Legislature. The eligibility of that route northward from Orange for a *rail road*, need not on this occasion be examined further than to sketch its course, as its comparative advantages will be ascertained in the *Reconnoissance* now making by Engineers of the United States from the Hudson to the Mississippi; the result of which may greatly recommend the first sections of a great work, interesting to New-Jersey and New-York.

It would seem to be the best policy of the General Government rather to *aid* than to undertake public works, even those having a *National* effect, or advantage. Perhaps it is justly supposed that the same calculations that would justify Congress in making appropriations for such purposes, in promoting commercial intercourse among the states, will induce capitalists to embark funds whenever there is certainty of co-operation to complete the work promptly; if unexpectedly found to require greater means than theirs embarked.

If I am not mistaken, it was with a view to this kind of aid that the corps of *Topographical Engineers* was by law authorized to be formed from among the liberally educated officers of the army, that on these occasions their reports might be referred to for local with scientific intelligence, whenever required by Congress, on the subject of any such application. The usefulness of this Corps has already been acknowledged on various occasions in different parts of the Union :—and prospectively it seems likely to become more so, since a *surplus Revenue* is incident to peace and National Prosperity; and to the American system, not only of political. but practical commercial independence. The world divided as it is into nations, they must act as such. The welfare of our own must of course be a paramount consideration with Government; and for the same reason that a free people must be protected against *foreign arms*, they must be so against the servile or cheap labor of all foreign people.

The canals of France, for example, made principally by Government to equalize prosperity, enabled her to circulate products without too much diminution of value by expense. Thus the cheapness of her Southern Wines in her Northern cities, in consequence of canals, has greatly increased demand, and encouraged the culture of the Vine. But excess of production in one kind of crop may reduce its price below what it can be afforded for. Thus *Indigo* was once the principal crop of our southern states. India interfered, and Cotton succeeded. Extraordinary demand, from improvement in machinery, spread this in turn over the new fields of the southwestern states, till the value has almost ceased to be a remuneration. The only remedy is to moderate the product by other crops; as the cane, the vine, the mulberry, and again indigo, for which domestic manufactures have *renewed the want*. But success in all this agricultural industry, after all, depends on cheap conveyance to market. The routes over savannas, rivers and mountains of an extensive country, can alone be properly achieved by the financial power of the nation, in aid of public spirit.

The difficulty of wielding this great financial power systematically vanishes if we apply the same care to public property that is given to private :—that is, to invest money so as to afford interest, and yet so as to be *convertible again to money* on the occurrence of an emergency. Thus the great exigency of war might be provided for without creating a *New National Debt.*

When war breaks out (and we well know this may happen from unexpected aggressions) the impost diminishes, and danger throws back from the ocean a large capital that would else have flowed away in the innumerable channels of commerce. These funds must seek secure objects of investment at the moment the government has occasion to sell out its shares in public works. *Thus, Internal Improvements* may *be* a *National Treasury:* not latent, inactive, and unproductive, but in precisely that form most beneficial to the whole people; and as efficient without being as dangerous to ourselves as so much money. Would not the existence of this great financial resource, *at command without taxation*, ready, if necessary, to sustain the arms of the nation, render its power more respectable in the eyes of other nations, and tend to preserve peace?

The system of care which applies to the public lands and other property, would be applicable to this, especially if a home department were separately instituted.

These general remarks on the application of surplus revenue, in which every state has some interest, have relation to the subject of this report, because it treats of the first grand sections of a route of national utility, reaching through the territory of several states, where private wealth is not pretended to be, however ample for private enterprise, equal to works of such magnitude as the interest of the people, and even of national property, requires. Certain it is

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that it would be no small encouragement to capitalists to undertake the nearer grand sections of national works under state laws, if assured of the aid of the United States, to construct the remoter sections, the execution of which would widen the attraction of accommodation and revenue.

The northwestern counties of New-York are conveniently reached in the summer season by the North river and Erie canal, but the *southwestern* counties would be reached from the sea port in less distance by a *rail road;* and in the winter season. But a part of New-Jersey intervenes. It will be easy, however, to show by facts, how the people of both states have the same interest in co-operation.

The Paterson Rail Road is believed to have a good prospect of ample revenue in its immediate business. Its extension is more interesting to other parts of the state than to the proprietors. To them, no doubt, it would be an advantage. It is a circumstance peculiarly favourable to canals and rail roads, so made as not to be injured by use, that every extension adds revenue to revenue. Indeed, this is more remarkable of rail roads, because they do not, like canals, depend on a command of water, and are not therefore limited by any local circumstance. Every obstacle may be systematically subdued.

Bergen Ridge occurs almost immediately on leaving Hoboken Ferry from New-York. It presents, on the direct course to Paterson, an abrupt side; an easier ascent, by going to Wehawken, at some loss of distance, may be found, yet it is thought, not without two inclined planes and stationary engines. Whether the route shall cross this Ridge by inclined planes permanently, or *pass through it* by *Tunnel*, attractive of all the travel of diverging routes beyond, and so situated as to make both ferries accessible, it is certain that the ground beyond fixes the passage of Berry's Hill at the *depression;* and the existence of the First and Second mountain, stretching far across Essex, broken through no where but by the Passaic at the Great Falls, makes Paterson a point in the supposed great route, independently of its own business; though it cannot be doubted that good policy and perhaps true economy will always justify inclining a line towards sources of revenue, and especially to large towns as their business occasions travel.

On arriving here, *Three Routes* present. In the choice of one of them, the computation of the resistance of gravity and friction,—the comparison of elevation, with level circuits, and the effects of power in climbing the one or running rapidly on the other, must decide.

The *Pompton or Pequanock route* is the most direct but elevated. I shall first describe it, and return by that of Morristown, and then follow that of the Ramapo valley. It is not necessary to be very minute.

Proceeding from the present rail road where it comes to the Turnpike south of the town, the line would pass in front of the new Factories, and rise to the elevation of the Dike, and after crossing it, widened, incline up the right bank of the river above the Great Falls to a place convenient to cross by bridge to the left bank; convenient, also, at this curve, to receive a line of railway from Morris county, eventually useful for winter travel from thence, and favourable to the Iron mines and manufactories, and even to the Lehigh coal trade at that season when the Pennsylvania and Raritan canals will be closed.

After crossing the Passaic the ground is favourable; the line would leave Little Falls Cotton Factories a short distance to the left, and crossing the Singac level lands, come to the left bank of the Pompton, cross it to the plain, and arrive at the entrance of the Pequanock passage of the hills—thus far being 11 miles, and the rise 93 feet.

The second section ascends the narrow valley of the Pequanock, which rises 47 feet in a mile, and in 11 miles, to Brown's Bridge, rises 514 feet, or 1 in 110.

The third section continues up the valley, more circuitously, 9 miles, to Henry Smith's swale at the summit, rising 240 feet, or 26⅔ in a mile—or 1 in 198. In all 847 feet.

The *summit* is two miles level across the mountain, consisting of a glade rather than a swamp, or both; giving rise to a brook which flows precipitately by a ravine near Is. Munson's dwelling unto the *Walkill*, near the *Franklin Iron Works*, three miles south of Hamburg Post Office. This ravine measures 7900 feet in length, with a fall of 382 feet, perpendicular measurement.

This descent might be effected by a Plane and stationary Engine, and perhaps with water power; in this case the line would cross the valley of this branch of the Walkill, and leave it by the opening near Dr. Fowler's dwelling, and thence take a direct course towards Newton village along White Ponds over quite a level tract. But it being pursuant to your orders, desirable to find a route suitable for Locomotives, the line would rather descend the mountain obliquely, through cultivated lands, in the direction of Sparta village, distant about six miles from the summit glade, and would turn across the head of the valley, about one mile from it; having descended 200 feet, or 40 feet in a mile, or 1 in 132.

Woodruff's Gap opens a passage through the next ridge. His Mill Pond occupies a part of it, and is the Eastern source of the Paulinskill.

The Paulinskill takes a serpentine and circuitous course around by Augusta to the Delaware, which it enters near the Water Gap; and our line might follow it down, gradually descending 10 or 12 feet in a mile. But it appeared to me desirable to keep as far as practicable on the southeast side of the ridge which rises along this stream, on account of a more extensive accommodation of Warren. My line, therefore, descends the Paulinskill about four miles, and then takes a direct course to the plain between Newton and Potter's Mill.

Newton is thus brought nearer the route than this village could otherwise be. The line now keeps up along Potter's Mill stream to a very large *Spring*, the source of the Pequest, which reaches the Delaware at Belvidere.

Marksborough village being on the other side of the ridge near where the valley of the Paulinskill inclines (if traced up) too much to the north, I was desirous of finding the lowest ground to cross in this direction; and after an examination of several places, the summit near Mr. *Lanan's* was found the lowest. Beginning therefore near the Great Spring before mentioned, the rise may be gradual for 3 miles at 1 in 115 feet. It then comes to the northwest, and descends the left side of the valley of *Lanan's* brook about a mile at half a degree, then curves to the southwest *on* the dividing ridge between this and Simond's valley, across whose farm it descends at the same angle, and passing through a narrow ridge, (that must be reduced about 30 feet,) gains the valley occupied by Col. Mott's farm, and at the same inclination, arrives at Marksborough village; descending in 2 miles about 182 feet, or 1 in 54. The continuation of this line at the same angle, two miles further down the valley, brings us to *Lawrenceville;* whence to the *Water Gap* the line being led along the north side of the valley is 10 miles, about level, making 67 miles from Paterson.

The *Andover and Morristown* route would (traced back) leave the Paulinskill at Lawrenceville. Its first step would be by Inclined Plane three fourths of a mile, at 2½ degrees. Thence to the summit, rising 77 feet in 2¼ miles, or 1 in 154 feet. It then descends very gradually, at 1 in 114 feet, to the Pequest Spring, leaving Johnsonburg a little to the south. The ground from hence to Andover is capable of a level route to near Panther Pond and Great Furnace Meadow, on the north side of which a small rise would require to be cut through, and on the south a rocky ridge ravine widened. Then Lubber's Run valley embanked to the foot of the Byram Ridge, a part of Schooley's Mountain. Here there must be an Inclined Plane with power to ascend it.

The summit would cross the Feeder of Morris Canal from Lake Hopatcong; and the descent on the southeast side to *Drakesville* require two Inclined Planes.

From *Drakesville* the easiest line is somewhat circuitous. Crossing Succasunny Plane, it turns the south end of Trowbridge Mountain, crosses Morristown plain, descends Whippanny valley, passes over Fairfield plain, to the right bank of Passaic, which it follows; being 36 miles from Drakesville to Paterson, descending at about the average of 1 in 317 feet. The whole distance to Paterson computed to be 66 miles, to Hoboken 81 miles.

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From *Sparta* there is a route by Norman's Pond intermediate to these two, but I found the ascent and descent higher and steeper than the others.

The *Ramapo Valley route* leaves Paterson at the level of Mill-street, to which the present rail road comes, and crosses the Passaic at this elevation to Quarry Hill—then continues along its eastern side northward to Ramapo works, rising only 100 feet in 17 miles; to the State line 15 miles.

I may here anticipate the question, whether a more eastern and more direct location might not be made? I was inclined to that opinion, till the ground was further examined. The elevation, as now proposed, corresponds with that of the line run for a Canal a year or two ago. There can be no more *eastern line of approach* to the Passaic from the north that would not both decline and rise, unless a very circuitous one were taken around the great bend crossing Saddle River, which comes in there. The advantage of the *Quarry Hill location* will be manifest, on presently applying the calculations of steam power.

In tracing the Ramapo route, I have, in *part*, adopted the survey for the State road, by Mr. Moffatt.

On running a line of level several miles, I found the Ramapo fell about 12 feet in a mile. But to leave the valley near Monroe Works, it will have to rise rather more.

At 11 miles from the State line the route leaves to the right *Smith's Clove*, a remarkable pass in the Highlands leading to *Newberg*, 15 miles distant, and to the left Townsend's Iron Works, and curves to the west, northwest, and southwest, up along *Crumline's Creek*, the outlet of Round Pond, and arrives near the village of *Chester*, (9 miles.) Thence it continues to the vicinity of *Florida*, (4 miles.)

The *State Road* line here leaves our route to the Water Gap, and runs nearly northwest across the outlet of the drowned lands, near Mr. Phillips' factory; gradually ascends to Mount Hope village; crosses the Shawungunk Mountain at Deer Park Gap; descends where an Inclined Plane would be required, to Basha's Hill; ascends the Nevisink to *Monticello*, the centre of Sullivan county; proceeds to Pierce's Brook, and descends to the Delaware, which it ascends 20 miles, rising 10 feet to a mile. This line is now under reconnoissance.

From Florida to Augusta the route is along the borders of the Drowned Lands, (now in the process of draining by a deep cut,) and reaches this village in 24 miles. (Still 25 miles distant from the Water Gap.) A choice of two routes here will offer; that of the Paulinskill valley, and that of Newton, by the Pequest Spring, Marksborough, or Lawrenceville. By either we may call the whole distance 88 miles from Paterson, without the necessity of a stationary Engine; or 104 miles from Hoboken without one, if Bergen Ridge should be tunnelled.

The Ramapo route is, it appears, 22 miles longer than that across the mountain. To compare them we must consider the resistance of gravitation, and of friction, combined. The two routes must be examined as regards time, and the useful effect of steam power in overcoming elevation on the one, and distance on the other. With the principles of these calculations you are familiar, and it is only necessary, on this occasion, to apply them in the plainest way; and this will be by example. Practice is more obvious than theory.

The experience of the Liverpool Company is the most instructive. They employ the best Locomotive Engines. Systematic transportation is there established. It is no longer experiment. We may refer to it with confidence; and there can be no reason why we should not in our country do as well. We have their Treasurer's published account of all essential facts in their history.

The power of these Engines manifested in speed and load, on levels and in ascending the Inclined Plane of Rain Hill, are data on which calculation may rest.

This ascent is 1 foot in 96 feet for 1½ miles (82 feet). Mr. Booth states, for example, that the *Comet*, with 28 tons behind her, first acquiring the speed of 16 miles an hour, passed up the Plane with it, gradually reducing her rate to 4 miles an hour. Thus her *momentum* was, in the beginning, of considerable effect: and had the ground permitted the ascent to be in two Planes, so that speed could have been recovered between them, there seems to be no doubt successive Planes might, in any line, be often repeated within the bounds of the adhesive force, or hold on the rails, which is computed to be 1-20 the weight of the Engine.

Mr. Booth enters into a calculation of the diminution of load to ascend a Plane at the *same* speed as on the level way:—At 15 miles he computes the reduction on a Plane rising 1 in 100 to be from 30 tons down to 7—and at 10 miles from 42 tons down to 12. Facts which prove the expediency of locating our Rail Roods *as level as possible.*

But this calculation is not so *practical* as one which will show *how fast*, with the same load, an Engine that carries a certain quantity on a level, will ascend any given rise. The following is an approximate calculation to that effect.

The *Planet* Locomotive, which commenced the regular business of the Rail Road in December last, carried on 18 wagons 135 bales of American Cotton, 200 barrels of Flour, and other merchandise, in all 51 tons, 11 cwt. 1 qr.: the wagons, oil cloth coverings, fuel, water, and attendants, 28 tons 8 cwt. 3 qrs.: together 80 tons, nearly 5-8ths load. The engine weighing 6 tons. Her speed on the level way with this load rather above 12 miles an hour. But on coming to the Inclined Plane, she was assisted by another Engine, together effecting its ascent at the rate of 9 miles an hour.

The resistance of gravity in ascending an Inclined Plane being as its height to its length compared with perpendicular or entire weight, it is estimated of course in pounds per ton, the height in feet divided into the ton weight; in this instance 96, the height of the Rainhill Plane, divided into 2240 lbs., is 23, 33 per ton—86 tons being 200" lbs.; and as Friction at 1-200 the weight of load, 80 tons, is 896 lbs., together 2902 lbs., overcome by 2 engines at 9 miles—which is 1451 lbs. to each, if equal. But as the Planet carried on a level her 80 tons at 12 miles, the friction of which was 896 lbs., her increase of speed appears to have occupied this difference, though it is more likely that the temperature of her steam was higher while the engine, resisted by gravity, worked slower up the Plane.

The exact measure of her power, therefore, is difficult to estimate without a knowledge of her strength of steam area and motion of piston per minute. I therefore assume, for the sake of a familiar example in practice, that the *Friction* of the Planet and train in motion was the true measure of her power, viz. 896 lbs, (as if it were so much weight suspended over a pulley, with the rope fastened to the wagons.) This would be 11 lbs. 20-100 per ton, which is not quite so much as the estimate for the common railway wagons, but it is more than Mr. Booth's estimate (9 lbs.) for the best of Mr. Stephenson's wagons, which is less than Mr. Vignoles found them, viz. 9¾. The 1-200 is indeed somewhat more than the axle friction of such carriages, but it is considered as the measure, also, of some lateral rubbing and some obstacle of the rail surface. The power, then, as above assumed, is not far from right, and may be thus applied to our Pequanock route.

The first section to Pompton rises 1 foot in 638 feet, the gravity of which is 3 55-100 lbs. per ton, amounting on 86 tons to 288 lbs.

The Friction of 80 tons, at 9 lbs., is - - 720

making - - - 1008 lbs.

which is 112 lbs. over her power *in diminution of speed*, and in the ratio of 1008 to 12 miles, so is 896 to 10 miles an hour her speed with this load at this ascent.

Thus the 2d section,	1 in 112,	would permit of about	4⅖	miles	per hour.
The 3d,	1 in 198,	" " "	6⅓	"	"
The 4th,	1 in 132,	ascending eastward,	5¼	"	"
The 5th,	1 in 115,	westward up Marksboro Ridge,	4½	"	"
The 6th,	1 in 54,	eastward up the same,	2½	"	"
The 7th,	1 in 154,	Johnsonburg westward,	5½	"	"

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It would enlarge this communication too much to adduce instances from Wood's Treatise, corroborating this estimate nearly. This may suffice to show, as I was desirous of doing, the *practicability of a Locomotive route*, at some expense of time, *within New-Jersey.*

And if we apply it to the Morris county route, with the exception of the Inclined Planes, it would be still more favourable, the intermediate sections being level, and the circuitous line from Paterson to Drakesville rising 1 in 317, which would permit of 7½ miles an hour, with the Planet and 80 tons.

Its application, however, to the Ramapo route is still more favourable.

The 1st section, to Ramapo works, is 17 miles, rising 100 feet in all, which is 1 in 897 feet. On the Liverpool road they regard 1 in 880 feet as a *practical level;* therefore on this section the Planet would carry her 80 tons at 12 miles an hour.

The 2d section, up that valley, (9 miles), might require for that distance an assisting engine to keep up full speed. The remainder of this route is *practically level.*

Thus we may suppose the Pequanock route to require time as follows :

1st sec.	11 miles,	1 hour,	6 minutes.
2d "	11 "	2 "	12 "
3d "	9 "	1 "	20 "
4th " 5th " 6th "	20 "	2 "	30 "
7th "	5 "	0 "	30 "
8th "	10 "	1 "	0 "
	66	8	38

Ramapo, Paterson to Line,	15 miles.
Monroe works,	11 "
Chester,	9 "
Florida,	4 "
Augusta,	24 "
Watergap,	25 "
	88, at 12 miles, is 7 hours, 20 minutes.

From which it evidently appears, that the *longest* route by 22 miles, being level, can be travelled in less time than the other.

The *Annual* expense of Inclined Planes is a further consideration against the elevated route. This expedient, and its Stationary Engine, though inestimably useful in crossing unavoidable elevations, and in enabling the rest of a route to be formed into practical levels, is a constant charge. To avoid delay, the power must be in proportion to the elevation, and to speed.

At the Ithaca Rail Road, the Inclined Plane 2 tracks, 1½ miles, is estimated to cost - 7560 dollars.

2 Engines, 30 horse power, high pressure,	7500	11019 dolls.
Buildings, Rollers, &c.	1500	
8 tons, 8 cwt. 2½ inch rope, at $12,	2019	

Annual expense :

Attendance,	$900
Other items,	100
Wood,	4200
	5200, annual expense.

According to practice in England, *this power* would require 7015 dollars annually.

The subject of *Friction* is necessarily involved in a comparison of a circuitous with an elevated route. It is an interesting one as regards the general effect of a moving power; it enters into the calculations of its economy, and it will appear that the means we possess of reducing its resistance is an *argument* for our most level route.

But the preceding general estimates or approximations to power and effect, have assumed the ratio of friction submitted to in England. Experiments there have fixed it at the 1-200 of the weight of load, which is 11 1-5 lbs. per ton. Even the best of Mr. Stephenson's wagons, with bearings external to the wheels, borrowed of Winan's improvement, makes it 9¾ lbs., and Mr. Booth states it to be 9 lbs.; yet as there is some lateral rubbing in a long train, and some surface obstacle, it is still considered that 1-200 is a fair general estimate of the ratio of resistance with common wagons.

But on the Baltimore rail road we know it is materially less; that the Company, in their invitation to competitors in Locomotives, warrant the friction of their *Winans wagons* shall not exceed 5 lbs. per ton, or 1-448 the load. Now whence this extraordinary diminution of resistance? The explanation may not be as familiar to others who may read this Report as to yourself. You will indulge me in enlarging on this subject, so interesting to the public. You will not have forgotten your first impressions on seeing the working model of Mr. Winans' invention, nor that of the citizens of Baltimore on its exhibition. It became the property of the Rail Road Company, and on a large scale was set to do the roughest work on the excavations; and from that time the principle has been tried in the heavy loaded and in the most rapid of the carriages, for several years, to the entire satisfaction of the Board of Directors, and the intelligent engineers who have been in the Company's employ.

Indeed, a question of so much importance as the mechanical means of doing the business for which the road was formed, could not fail to receive the strictest consideration of the chief Engineer; and I think both the inventor, the Company, and the country, are indebted to Mr. Knight for his skillful and scientific investigation of its principle, and the best preparation or adaptation of it, on the whole, to the Baltimore Rail Road.

And it appears to me, so far as I am entitled to form the opinion, that the reasoning concerning it in his report to the Board of Directors, is sound and thorough. It was certainly important that the flanges should be at the inside, and I am convinced that the union of the *cylindrical* and *conical rim* has, with the mechanical perfections given to this wagon by Mr. Winans since his return from England, made it all that was requisite, and perhaps desirable, of its kind.

The credit is certainly due to the American Engineers, that the principles of operation on rail roads have been investigated more deeply and mathematically than they had been in English publications; and while the friction has been thus reduced, the utmost steadiness has been given to the passage of curves of a much smaller radius than they there deem practicable, yet preserving the advantage of fixing the wheels to the axles. The properties of the Winans car, it is acknowledged, have contributed to this result, as well as to the greater useful effect of the moving power employed.

That the principle has not yet been carried so far as it seems capable of, in the limitation of the wheels to the convenient size of 2½ feet, is perhaps true. Whenever routes shall offer less subjected to short curves than the valley of the Petapsco, I do not perceive any material objection to their being made at least three feet in diameter.

In this case, with the friction wheels in proportion, we may see realized our original expectations here, and in practice, corresponding to the results of experiment in England, where, on the Liverpool and Manchester Railway, with wheels of this size, some experiments were made to test the comparative friction against the best of their wagons without friction apparatus.

The account of these experiments, under the inspection of Mr. Vignoles, one of the most eminent Engineers of that country, were published in the *London Mechanics' Magazine for February*, 1830, *page* 461, where it appeared that each carriage loaded with four tons, each having 3 feet wheels, manifested their respective ratio of friction,—Stephenson 9¼, Winans 2½ lbs. a ton; and in perfect confirmation of this, the latter would run spontaneously, or *by gravity* alone, down an incline of 5 feet, 10¾ inches in a mile, while the usual estimate for other wagons is 26 feet, 4 inches a mile. The gravitating force of this elevation being equal to their *friction on a level.*

It may at first appear difficult to reconcile to this result the apparent indifference of those in England interested in such effects of an improvement of this kind; and still more so for a statement favourable to Mr. Stephenson's wagon in the *new edition* of Mr. N. Wood's Treatise, in the face of the published account of it. But the fact was (as I learn from Mr. Winans) that the trial Mr. Wood describes was reported to him from among those done from curiosity rather than to test a principle. It let both carriages run down an Inclined Plane, to see how far they would ascend an opposite one. This was therefore a test of *momentum* against *gravity* combined with friction, and proved nothing

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as to *comparative friction* alone, which is the question, as gravity operates equally against all kinds of carriages.

If then we apply this improvement to our middle route, it would considerably increase the effect of the power of the Planet Locomotive, but not near so much as by the Ramapo route.

A few figures will illustrate this subject from preceding data. Thus, assuming, as we well may, that the principle of the friction may be carried as far as it was in the demonstration under Mr. Vignoles, and that the tractive power of the Planet Engine was 896 lb., then in the ratio of 2½ lb. to a ton resistance, she would draw no less than 358 tons on a level—or if the comparison of ratios was 9¾ to 2½, then 312 tons. In fact, the rise from Paterson to Ramapo is less than that considered a practical level on the Liverpool rail road, 1 in 880 feet: this being 1 in 897 feet.

When they shall at Liverpool, have time to perceive that their Engines might, with the use of these wagons, be more than twice as efficient, it may be presumed that interest will lead to their adoption.

The question of comparing two routes, the one mountainous the other level, has not often occurred in our country. Most of the rail roads as yet projected, have been compelled to ascend vallies like that of the Patapsco and Potomac; or have had before them a level country like Raritan and Delaware, Frenchtown, Washington and Charleston. But occasions may arise in which the alternative may be very much influenced by the consideration of effective power, or the time lost or gained by circuit and level.

Another topic is suggested also by the *diminution of resistance from friction*, that may be often of great consequence, considering how *extensive* our lines of communication require to be. If the friction wagon should be the means of saving cost in the railway itself, the wide range of this economy invites me to take this view of its possible utility in this respect.

The grounds of this expectation are, that it will permit of lighter Locomotive Engines, sufficiently powerful for as long a train as may be conveniently used.

We know that the Liverpool and Manchester rail road was calculated for much *heavier Locomotives* than have been found abundantly efficient.

The question then is, can we have firm, durable and smooth rail roads of *edge rails* at less expense, in consequence of using *lighter engines?* The answer includes some reference to what rail roads of different kinds have cost, independently of ground and graduation, which must always depend on local circumstances.

The Ithaca estimate for a Timber and Plate rail, *one track* is $5502 a mile. Here the ground and graduation is a small part of its cost.

The estimate by Gen. Swift for the Baltimore and Susquehanna road, of Timber and Plate, exclusive of ground and graduating,	$5,158
The same for Iron rails on stone, exclusive of Engines and Inclined Planes, ground and graduating, one track,	6,279
Providence and Boston estimate,	5,524

Of which the Iron was $848.

The estimate for the Beaver Meadow and Easton single track rail road, (by Mr. George Merrick,) with edge rails as heavy as those of Liverpool, 57 tons a mile, at $65, is, (Iron,)	$4,636	
Foundation stone and setting,	3,520	
	$8,156	a mile.
Graduation in this place along the Lehigh, (very expensive,)	4,500	
	$12,656	

The cost of Iron rails of the Liverpool railway:

110 tons of Iron per mile, at	$55 10,	$6,105
41 tons of Chair, at	46 67,	1,920
Spikes and Keys,		488
Oak Plugs,		137
		$8,650
Of which one half is		4325

Road formation, consisting of the broken stone 2 feet deep, and stone blocks, adjustment, &c., 18 miles out of 35, about (17 miles on wooden sleepers.)	5,000
	$13,650

The other items peculiar to that place were enormously expensive.

Experience at *Baltimore*, appears by the reports, to be as follows:

For wood sleepers, wood bearers and plate rail, exclusive of ground and graduation, one track,	$4,362 per mile.
Stone blocks, wood bearers and plate rail, of which the cost of Iron was $1,324,	5,115
Granite sills (in line,) with plate rail, of which the Iron was $2,037 64,	6,500

The analysis of this expense is,	sills at $11 50 per 100,	$3,680
	Bar Iron,	1,300
	Broken stone,	640
	Various items,	880
Including labor.		$6,500

The objections to this method in a northern climate are, that it is not so capable of protection against the effects of frost in the foundations, as posts would be, nor of the elevation above snow and ice, requisite there.

At Providence, the estimate was for the split stone at 17 cents a foot:

If every 4 feet of the track took 2 posts of 3 feet, it would be,	$1,346 40
Holes ¼ of a yard, 2,620 holes, 655 yards at 10 cents,	65 50
Setting and filling, at 10 cents each,	262 00
Cutting top and drilling holes, at 10 cents,	262 00
Edge rails for 3 ton loads, half the weight of Liverpool rails, 28 tons a mile, at $65,	1820 00
Chairs, 14 tons, at $45,	630 00
	4,385 90
Other items, 10 per cent.,	438 59
	$4,824 49

The calculation in England for heavy Engines, has augmented the quantity of Iron used, beyond what is now necessary.

The above, therefore, may approximately show that we *may* have railways in a durable form for loads of 2 tons, wagon's weight 1 ton, and light Engines; since they will be able to carry large loads on friction carriages, on nearly level routes; and thus the suggested form of construction may have the properties of elevation, free drainage, stability, and prevention against frost, without being more costly than *the less durable form* of railways.

Solicitude for *cheap* rail roads has been generally manifested in our country. It has been thought that the great length of our lines of communication would require it. Timber has been employed; and doubtless, in some situations, with due precaution, it will be expedient; but you have at Baltimore, already departed from that plan; and if I am correctly informed, experience thereof at Charleston has not been favorable to its use; their Engine indenting the wood under the rail, and making lodgment for rain water, heat and moisture must consequently, have full effect in producing early decay; certain precautions might however be used. Baltimore is avoiding this liability by the use of stone sills in continuous line; but these are not so much at command in South Carolina.

In adopting this plan the Engineers were not unaware of the importance of so *consolidating* the broken stone below them as to exclude water, lest ice should form and heave the sills upward. Their keeping in place will very much depend in the north on the success of this design. Indeed, it will not be easy to exclude the water *from between* the sill and its foundation. In England and our southern States, the mildness of the climate renders this precaution less important; but on the routes the subject of this Report, it may be indispensable. This difficulty here has suggested another expedient, which is however, encountered by another, to be first provided for. It is, that on every route the graduation involves the necessity of *embankments*, which are of course, ex

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pected to *settle*, and to require temporary foundations for the rails, commonly *cross sleepers of timber*.

The *remedy*, however, is obviously at hand. It rarely happens that the location of embankments is not near some stream: and it is a familiar thing with Engineers, that they can, by the use of water, make embankments at once as solid as time can ever make them; so that any kind of permanent foundations might be at once used, were this precaution taken; and thus, there is no insuperable objection to the use of Posts. Their use also suggests the use of piles in crossing meadows, swamps, and marshes. On the Charleston rail road, being over a sandy soil, they have employed them wholly; and some of them stand out of ground even 11 feet, and are not disturbed by the rapid travel of their Locomotive Engine.

The *Sources of Revenue* comprehended on the one and the other route under consideration, belong to this comparison. If the location can be made to accommodate the main object, yet embrace several others of value incidentally, it is the more recommended. Such appears to me to be demonstrable in the Ramapo route; and it is a great recommendation of an undertaking of this kind, when every successive section reaches an object great enough to sustain that section.

We may consider the 1st as reaching Paterson, already one of the largest manufacturing towns of our country, possessing a water-fall immediately of 70 feet, not yet fully occupied, and capable of sustaining a very increased population by the aid of all its hydraulic power. Were the rail road to stop here, the business of this place alone, would be an adequate object. This, I am aware you think, would not be the most liberal policy.

The second section reaches the Ramapo valley, also the seat of successive establishments for the manufacture of Cotton and Iron, adequate to the recompense of this section. The *sterling ore* is well known to be excellent in quality.

The 3d may be considered as a branch through *Smith's clove* to Newberg, principally useful for transportation in the winter season to and from that thriving town, which stands in the same relation to an extensive interior district that Albany does to another portion of the state, and were it only for the five winter months, must give an ample revenue to this section.

The 4th continuing the main line, reaches the centre of the populous county of Orange, where manufactories again, and all the usual forms of agricultural industry occur. Between Goshen and Florida the North-western line would diverge from the Water Gap line, and crossing the Blue Ridge at Dear-Park Gap descend to the Hudson and Delaware canal and cross it near Carpenter's point about midway from its two extremities: where its course takes a turn to the North east about 60 miles to the Hudson, and if this bend should become the site of a Depository it is probable that considerable business would originate here in the winter months. But this route continues (as surveyed for the State Road) to *Montecello* at the centre of Sullivan County. Thence it reaches the upper branches of Delaware River, 16 miles from the Susquehanna, which comes hither 80 miles along the borders of Otsego, Chenango, and Broome. This is the route under reconnoissance as before mentioned; But a meeting at Ithaca has expressed a favourable opinion of that I shall proceed to describe.

The 5th section of our main line proceeds to Sussex County, on the eastern mountain border of which lies the most remarkable body of Zinc in the Union, and near it is found Iron ore, of the silicious kind, making with a mixture of the Succasunny ore excellent iron. And near it lies conveniently to its use as a flux of the ore, a fine body of *Fluate of Lime*, which besides its excellent Lime (carted now to Paterson) affords a fine *white marble* much in demand.

The 6th section embraces all Warren county, fertile but not fully occupied. Capable of a far greater population, yet possessed of much industry and many mills, and some Cotton Factories, wanting only accessions of raw material and cheap access to market.

The 7th section reaches the Water Gap and the borders of Pennsylvania. It here reaches Delaware River, which has a descending navigation in times of high water, for several hundred miles. At the Gap is situated a very successful quarry of fine Slate, in operation. Not far from it is the large village of Stroudsburg, with its large flour mills.

The 8th sectiien crosses a part of the counties of Pike and Luzerne, full of very valuable lumber. Shingles are now carted from thence to the east of Hamburg mountain *cheaper* than to be had from elsewhere.

The 9th consists of the Coal valley of the Lackawana, which it enters 8 miles below Carbondale, and 40 miles from the *Great Bend*, north—for which distance also, a rail road privilege has been granted, which will greatly benefit the Hudson and Delaware Company, by opening a vent for their Coal to the western counties of New-York. It leads to Owego and Ithaca and the Lakes.

The 10th section descends the Lackawana 15 miles to the Susquehanna and Wilkesbarre, and joins the Pennsylvania northeast Canal leading *southwest* to the main line west to Pittsburg—while from the northwest the river comes from the county of Steuben, and the fertile districts of the Genesee.

It will be cheaper and shorter to proceed from New-York to Wilkesbarre by rail road, and there take the canal for the west, than to go round by Philadelphia. And for produce, the market of New-York is thus opened from Pennsylvania direct.

It would be obtrusive to enlarge on topics so familiar to yourself and others. One of these sources of revenue, however, is of great value, both to the industry and useful arts of our country, and even to the formation of rail roads. I am persuaded you will admit here a few remarks in detail, and not deem them misplaced. I allude to the *Iron manufacture*, which occurs so often on this route.

The *Suckasunny ore*, considered the richest in New-Jersey, is so situated as to be carted at moderate expense, to the Hamburg mountain ore; and might also descend the Morris Canal, to meet it at Paterson. The Sterling mountain ore, near Ramapo, is of a kind that works well, without admixture. In the vicinity are situated the great Furnace of the West Point Company, and another large establishment of the Messrs. Townsends; another also of the Messrs Lorillards.

The other most remarkable Iron mines in our country, are those of Peru on Lake Champlain, that of Bennington, and in Connecticut on the borders of the *Housatonick*. The small number of places where Iron is found, though in them found in vast quantity, gives great importance to the Ore of the north of New-Jersey, to be the subject of cheap conveyance to market, and bringing to it a fuel (in the *Anthracite*) capable of use at less expense than charcoal.

The expense of carting a ton of Iron from the county of Sussex to New-York is $10. It requires 2½ tons of ore to make 1 ton of Iron. A ton of Iron requires 800 bushels of charcoal, which commonly costs 4 cents, and comes to $32. At the price it brings, $65 a ton, unless very excellent, it scarcely pays additionally, the labor and interest. But a railway saving perhaps three-fourths of present expense of carriage, and bringing mineral coal, would give a great impulse to this branch of industry.

All the Bar Iron we use in our country costs us twice as much as Iron costs to the people of England. Every thing should be done in good policy, to induce capital into this great branch of business, on which all the arts, and all agriculture, and even our National defence has to rely. If there is any one branch of manufacture, more than another, deserving the fostering protection and encouragement of a National paternal government, it must be this.

In New-Jersey a Bloomery Furnace commonly yields one ton a week, or 50 tons a year. The whole quantity made in the United States is supposed to be 120,000 tons. But in Great Britain they make, it is stated, 800,000 tons, value there at $50 a ton, 4 millions of dollars.

In 1740 they used charcoal only, and a Furnace yielded 5 tons 13 cwt. a week. By at length using Pitt Coal and bellows, they raised it to 11 tons a week; and by the year 1796, the use of Charcoal was quite abandoned. The Mineral Coal containing some Sulphur, causing the Iron to be brittle, the next great improvement was the *charring* of it for use. Thus made into *coke*, at the loss of 50 per cent. of its weight, yet retaining its carbon, with less ponderosity it burned more freely without being too heavy a burden to the furnace. This well known process, you will recollect, converts the ore from an oxide of iron to a carbonate—in which combination it is fusible as soon as the earths combined with it, are also made fusible by the admixture of another earth, as

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lime with clay, and the complete smelting is effected by the blast at the bottom of the chamber of the Furnace where this preparation takes place.

The Pig Iron thus produced is remelted and decarbonized in the *reverberatory furnace* using bituminous coal, which affording flame, appears to be preferable to coke. The Iron is, by this process, made malleable, and refined by re-heatings and rolling.

The application of no other fuel than Mineral Coal in its native and carbonized forms, and the use of a powerful blaze, and substituting rolling for hammering, so advanced the art in England, that it has become practicable for the smallest establishments, three furnaces, to afford 150 tons, and some 300 tons a week; and to make it an article of profitable export.

Some of these establishments are much larger, and employ three Steam Engines of 200 to 350 horse power. But a 28 horse power is enough for 1 high furnace and 1 finery, and 1 high furnace gives 50 to 60 tons a week; as much as our Bloomeries give in a year.

The process of roasting the ore is supposed to facilitate its fusion, by expelling volatile constituents. It requires 3½ tons of ore to make a ton of Iron.

The bituminous coal which England has is very much in favor of this manufactory there. Burning with less rapidity than charcoal, it permits of giving to the furnace a greater capacity, and of making more Iron in a given time with the same workmen; while the use of charcoal makes Iron costly here, as it did at first there.

We also have bituminous coal in the west and north of Pennsylvania, near Richmond in Virginia, and on the Potomac, to which the Baltimore rail road is approaching.

Anthracite is now used very advantageously in the cupola furnaces, preferably to any other, and makes the best castings; smooth, homogeneous and soft for machinery. It is very desirable also, to employ it, being a natural coke, as they do the artificial coke in England in smelting the ore.

I believe there is a method that will answer this end, and if so, make this coal an important source of revenue to the rail road.

The State Legislature it is worthy of remark, have, by the liberal views expressed in their frequent laws, granting leave to open commercial routes to the great markets for the sale of produce, evinced that regard to political economy, which supercedes the influence of State partiality to its own capital. It is in fact of little importance whence the profits come back to the people.

The boundaries of the American States were fixed before the country was known. Those lines now regard only jurisdiction, but are no barriers to trade. It is of the nature of trade to flow where there is least obstruction and most facility.

From New-Hampshire to Louisiana every State contributes, by the oblique course of the rivers, to the commerce of its neighbor; as if nature had intended to form the Union by laws as strong and durable as gravitation. And it is clear that the idea of a Nation, without power to do all that its internal as well external interest requires, is an absurdity; and as the States, as such, have no power beyond their own limits, the power of doing works required by defence or by commercial interest, must reside *somewhere;* and where else, if not in the general government, which holds the common purse. Indeed, so happily blended are the interests of the states, that in aiding any great work on any parallel of latitude in the union, its good effects reaches several states, and relatively all; as is exemplified in the routes I have incidentally described as having relation to the subject of this report.

In conclusion, I may presume to suggest that it will be for the advantage of the people of the northern counties of New-Jersey, and of the southwestern counties of New-York, together with those of Orange, and those of the metropolis who feel an interest in the subject, to make application to the Legislatures of both States for leave to make a rail road from the boundary line of this State at the Water Gap to meet that now making; and if, through Orange and Rockland counties be preferable, then respectively connecting at the boundary lines, and from that on Rockland to Paterson.

I have the honor to be,
Very respectfully,
Sir, your most obd't. st.
JNO. L. SULLIVAN.

HOUSATONICK.

P. S. Having incidentally mentioned the Iron of Litchfield county in Connecticut, in may be due to that part of our country, to show by what means its interest, in this branch of product, would stand on a footing with those of New-Jersey and New-York, mentioned in the preceding report.

Housatonick River takes its rise in Berkshire, in Massachusetts, north of Pittsfield, and flowing southward through Stockbridge, Great Barrington and Sheffield, enters Connecticut, and after running southwesterly through Salisbury, Sharon and Kent, turns northeast nearly to New-Haven, and then south to the Sound at Stratford. From Kent to Salisbury, Iron ore is found and wrought successfully. Kent gives 2000 tons, Sharon 800, Amenia 800, Salisbury 2000, Canaan 2000, Lenox 1000; thus at present, producing 8,600 tons.

The various other branches of manufacture carried on in this populous part of the State, had already suggested the advantage of a canal down the valley of the Housatonick; and a Board of Commissioners have been named, who intend, I am credibly informed, to suggest to the Legislature at its next session, a change of the privilege to that of a rail road, founded on a belief that it will better subserve the interests of this fertile and populous part of the country, and permit of reaching the Sound at a point nearer the City of New-York than could otherwise be done. Thus it will be very easy to leave the valley of the Housatonick at New-Milford, and ascending the valley of Still River to Danbury, pass through a very level country to Saugatuck Harbor, near Norwalk, 30 miles west of New-Haven. The ground along the Housatonick is described to me as favorable, and I well recollect its being so through this part of Berkshire. Throughout this valley there are immediate and lateral inducements for this work, and there must exist ample encouragement I believe for at least one track of rail road. From Pittsfield to the Sound is 111 miles, and should the travel render it worthy of the expense, its continuation 30 miles, would join it to the Harlaem rail road, if made. To give some idea of the business done in the valley of the Housatonick, there may be enumerated 160 stores. The revenue of the rail road would be derived from Agricultural Products, Manufactures, Iron, Coal, Marble, Lime, Merchandise, and Passage.

The railway wagons should enter on the deck of a steam boat provided with rails, and be run into a warehouse, unloaded and reloaded to return, that there may be no shifting of goods between Pittsfield and this city, and there will be little time in winter when this intercourse will be necessarily interrupted. Land carriage from Kent to Norwalk is now 13 cents a ton, a mile. But by rail road it might be 3 cents. Here is an instance in which the interest of two States is blended in one work, contributing to the Commerce of a third.

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The writer of the following Letter resides in Luzerne, Penn., and is a Commissioner, under the law mentioned in the first paragraph of the preceding Report:

(COPY.)

Luzerne County, Penn., Sept. 24, 1831.

COL. JOHN L. SULLIVAN,

Sir—Yours of the 14th is just received, informing me of your having accomplished your reconnoissance from Paterson to the Water Gap, and requesting from me some general account of our survey from thence to the Susquehanna, which may not anticipate our Engineer's Report, &c.

I am desirous of avoiding giving any thing in anticipation of our Engineer's intended Report, and at the same time furnishing some account in accordance with your request. But I find it a more difficult task to generalize a subject of this nature than I had anticipated. Our line as run, maintains on our summit a perfect level for probably 15 or 16 miles. Thence an easy grade calculated to accommodate the ascending trade from the coal range.

The last 18 miles of our line is located *within* that range. The last 10 miles of this next the Susquehanna will probably be graded at 14 to 15 feet per mile, with occasional levels, so as to accommodate in the fullest manner, the vast deposits of coal which abound upon our line, and on each side of it.* We cross the Pennsylvania Canal near the Lackawanock, at an elevation determined on that work, for the height of its Bridges, and pass on about 2½ miles further to the Susquehanna River, intending to accommodate the interest floating on that stream.

Our distances I do not correctly know. Our line, however, was lengthened considerably, as you may suppose, by keeping a long level summit. On an actual location it may be shortened.

Some of the Coal of the Lackawanock formation is ascertained to exist near 1100 feet above the western end of our line. No unusual or unexpected difficulties or impediments have as yet occurred. Neither deep cutting, nor heavy embankments, nor as I believe, expensive sections. We have command of sufficient water power, whenever it may be deemed proper to use it. Our curves are easy—our Bridges will not be expensive: and materials, stone and timber, every where abundant.

Our Engineers are now descending towards the Water Gap, on which part of the line a Higher Grade will probably be found admissible than on our western declination. I presume that all the next month will be consumed in this service, and that it will be near the close of the year before our Report will be made public.

There are various very interesting considerations attendant on a contemplation of this line. The ease of the extension from it to Owego, (we have kept the Hillside North of Roaring Brook;) the consequent connexion with Carbondale. It may also be fairly presumed that at no distant day the Susquehanna River will be improved to the State line, either by continued Canal or Steam Boat navigation, (which is fully practicable,) or by rail road along its valley; in either case, accommodating a very interesting section of Western New-York, which thus by our rail road, and an extension through Jersey, would be directly connected with its commercial capital.

Whilst touching this subject, permit me to call your attention to the projected examination of a line from some point on the Hudson River to the valley of the Mississippi. This service is confided I believe to Col. Clinton, who is authorized to make the survey for the United States. Can a better line be found than one direct from the City of New-York via the Water Gap and Pittstown—thence up the North Branch of the Susquehanna to Tioga Point—thence up the Tioga River to the Carvanesque—thence up that stream to where it interlocks with the Head Waters of the Genesee River, which *waters also interlock with those of the Allegheny* River—thence down the Allegheny to Pittsburg, and down the valley of the Ohio to the Basin of the Mississippi—is there any other line on which there would be required so small a proportion of stationary power, or which would be more accommodating and useful, whether in time of peace or event of war? I think there cannot be found any other so generally accommodating. Cannot interest be made to have this Route examined?

I shall be much pleased to see your Report from Paterson to the Gap—ours you shall have when completed. Excuse this hasty letter, and believe me,

Very respectfully, yours,
HENRY W. DRINKER.

P. S. I have no hesitation in expressing my belief that coal can and will be placed on our rail road *in the cars* at 50 cents *per ton*. The transportation you can perhaps calculate without much error. If *this Item* is reasonable, from whence can any competition arise? The corporate debt of the L. company demands near $2 a ton at M. C. to pay its interest—or more than this, unless they transport much more per annum than they yet have done.

The inquiry contained in the postscript of the above letter of Col. Drinker, respecting the expense of carrying coal on the rail road from thence to New-York, must be answered with some qualifications. The rate of toll must be such as to give an ample remuneration to the stockholders, and this of course depends on quantity. The actual expense of carrying per ton per mile is answered by experience on other well built and well regulated railways using locomotive Engines; and if we may give implicit credit to the published statements it is very moderate; and seeing no reason why our rail roads may not be nearly as well managed, I shall give these statements as a near approximation to it. Mr. Booth, in his account of the Liverpool and Manchester Rail Road, computes all expenses, including assisting Engines at the Inclined Planes, the water stations, and 7½ per cent. interest on capital, supposing full employ, at 164 thousandths of a penny per ton per mile; which if the whole route were 130 miles is 21½ pence, which is 39½ cents. But as so long and varying a line cannot be managed with so much precision as so short and active a line as that is, no doubt it will be something more, but how much more experience alone can determine. If it were even 1 cent a ton a mile, it would be at the Hudson, $1 80 per ton, cost and carriage. J. L. S.

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Paterson, Oct. 7th, 1831.

J. L. Sullivan, Esq., New-York,

Dear Sir—I had the pleasure duly to receive your communication, with enclosures, but have been so entirely engrossed with my official duties that I have not been able to gratify my desire to reply to your inquiries until now, and even at this time, from a continuance of the same cause, I must be very brief.

The Baltimore and Susquehanna rail road is graduated for a double railway, and is now in operation for a distance of seven miles. A single track only with the requisite turns-out, has as yet been laid. Its construction is such as proposed in my Report, (a copy of which is herewith enclosed,) and its cost so far. about the same as was anticipated in my estimate—or say $12,500 per mile, Contracts have recently been entered into for the construction of a branch from the B. and S. R. R. towards Westminster, extending eight miles—the cost of which will be about $10,000 per mile.

That portion of the Paterson and Hudson River Rail Road extending to the village of Aquacknonk, and which will be in operation during December next, will have cost, it is believed, less than $10,000 per mile—its construction being similar to that of the B. and S. Rail Road, and portions of the B. and O. R. Road. The construction of the Albany and Schenectady Rail Road, about which you also inquire, is similar to those alluded to above, with the exception of the substitution of stone blocks and chairs for the wooden sleepers.

I am, dear sir, very respectfully,
Your obedient servant,
WM. GIBBS McNEILL.

SUPPLEMENT.—ON THE SUBJECT OF THE FRICTION WAGON.

Something more definite should have been said on the results of the experiment thus far at Baltimore with the improvement in railway wagons, especially since its value I find begins now to be acknowledged also in England, where Messrs. Ericcson and Braithewait have, as agents for the patentee, undertaken to make them. Yet this improvement may still be considered as progressive at Baltimore, though thus far, entirely satisfactory. Local circumstances there compelled the formation of curves on a radius of only 400 feet, and limited the travelling wheels to 2½ feet diameter; and other considerations fixed the internal diameter of the Friction Wheels at 9 inches; which of course lessened the saving that larger dimensions would have made. But even thus to an extent *unexceptionably practical*, when the work and way are as well executed as usual, the resistance of friction is reduced to 4 lb. a ton. That is, a weight of 4 lb. affixed to a cord led over a pulley to the car, would draw 1 ton; or a horse whose power is 120 lbs. would draw 30 tons—at his working pace, on a level—which is *three times* as much as used to be the load of a horse on the best English made railway carriages.

The Locomotive Engine now operating successfully on the Baltimore road made by Mr. Winans, to run on a Friction carriage, though of moderate power, has great useful effect.

Mr. Winans also made, at an early period, another improvement: an intermediate step towards his most complete wagon; and as it is of considerable value, and peculiarly useful in the formation of embankments and the making excavations of the ground for railways, and the roughest transportation on them, I here mention it as a patented improvement, offered to notice thus seasonably, at a period when works are every where in our country being projected.

It consists of extending the axletrees far enough from the hub of the wheels, to be formed into a small journal, on which the load frame is lodged. The friction is by this means, reduced from 11¾ down to 8 lb., especially with his apparatus to make them more yielding, or less stiff.

Companies have now the choice of these two improved wagons, and may refer to their actual performance on the Baltimore road, and be supplied from thence by experienced workmen, on very moderate terms. Having myself an associate interest with the inventor, applications may be addressed either to himself or to me. And I can easily demonstrate that companies will save more in one year than the right for ten or twelve would cost. Thus, suppose a friction carriage right cost 50 dollars, and it carried only twice as much, or required half the power that others do, and it should be considered that the expense of carrying on other carriages were 1 cent a ton a mile, how many miles would a wagon carrying 2 ton loads have to travel to earn or save $50? the answer is, only 2500 miles, which at 10 miles an hour, is 10 days work.

It is believed on present data that the moment the Baltimore rail road is opened to Frederick, 60 miles. The friction carriage will save annually more than the patent right cost the Company; perhaps between 14,000 and 20,000 dollars annually on this part of the business of that road: probably 2 per cent. on its whole cost; and would therefore add one fifth to its value.

There has not been quite enough said on the excellent property of this carriage in adapting itself to the curves of a rail road. There could aforehand be no doubt that a curve would be travelled with least resistance if the two axletrees might quit their parallelism and adjust themselves each to the line of radius, or point to the centre of the circle on a part of which the car is moving. This it in fact does by its property of self-adjustment to resistance, combined with the conical part of the rim of the wheel, which at the same moment is by the projectile force and by the greater resistance of the greater length of the outside rail, brought to act. Thus the combined effect of the mobility of the axles in their own plane, to some extent, co-operating with the calculated cone of Mr. Knight, absolutely prevents increased resistance at the curves. J. L. S.

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